09/833833

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313 on April 12, 2007.

James S. Parker, Patent Attorney

REQUEST FOR CERTIFICATE OF CORRECTION UNDER 37 CFR 1.322
Docket No. NAN-105XC1
Patent No. 7,135,133

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants	:	James K. Walker, Jacob Ralph Tymianski, Bongsoo Lee, Stephan A. Tuchman, Won Young Choi
Issued	:	November 14, 2006
Patent No.	:	7,135,133
For	:	Method and Apparatus for Manufacturing Plastic Optical Transmission Medium

Mail Stop Certificate of Corrections Branch
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REQUEST FOR CERTIFICATE OF CORRECTION UNDER 37 CFR 1.322 (OFFICE MISTAKE) and 1.323 (APPLICANT MISTAKE)

Sir:

A Certificate of Correction (in duplicate) for the above-identified patent has been prepared and is attached hereto.

In the left-hand column below is the column and line number where errors occurred in the patent. In the right-hand column is the page and line number in the application where the correct information appears.

Patent Reads:	**Application Should Read:**
Column 1, lines 14-16:	Page 1, lines 13-14:
"Graded index plastic optical fiber (GI-POF) offers promise as a high bandwidth communication medium. The ability to create a desired index of refraction profile in a plastic optical fiber"	"Graded index plastic optical fiber (GI-POF) offers promise as a high bandwidth communication medium."

Patent Reads:	**Application Should Read**:
Column 3, lines 35-36:	Page 5, line 1:
"not containing and additives"	-- not containing any additives--
Column 14, Table 5, last col.:	Pages 20-21, Table 5, last col.:
"Refractive Index Index"	"Refractive Index"

Patent Reads:	**Page 5 of Amendment dated 4/21/06 reads**:
Column 21, line 64-65:	Claim 16, line 4 (Claim 15 in patent):
"with refractive indices $n_1{}^1$ and n^{31}"	"with refractive indices n_1^1 and n_3^1"

Patent Reads:	**Page 6 of Amendment dated 4/21/06 should read**:
Column 22, line 14:	Claim 19, line 2 (Claim 18 in patent):
"of benzophenome"	--of: benzophenone--

Patent Reads:	**Page 8 of Amendment dated 4/21/06 should read**:
Column 22, lines 64-65:	Claim 42, line 3 (Claim 30 in patent):
"heated enclosed comprises"	--heated enclosure comprises--

A true and correct copy of pages 1, 5, 20, and 21 of the specification as filed and pages 5-6 and 8 of the Amendment dated April 21, 2006, accompany this Certificate of Correction.

The Commissioner is authorized to charge the fee of $100.00 for the amendment to Deposit Account No. 19-0065. The Commissioner is also authorized to charge any additional fees as required under 37 CFR 1.20(a) to Deposit Account No. 19-0065. Two copies of this letter are enclosed for Deposit Account authorization.

APR 18 2007

Approval of the Certificate of Correction is respectfully requested.

Respectfully submitted,

James S. Parker
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Enclosures: Certificate of Correction; Copy of pages 1, 5, 20, and 21 of the specification as filed; Copy of pages 5-6 and 8 of the Amendment dated April 21, 2006

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,135,133 Page 1 of 2

APPLICATION NO.: 09/833,833

DATED : November 14, 2006

INVENTORS : James K. Walker, Jacob Ralph Tymianski, Bongsoo Lee, Stephan A. Tuchman, Won Young Choi

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APR 18 2007

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

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DESCRIPTION

METHOD AND APPARATUS FOR MANUFACTURING PLASTIC OPTICAL TRANSMISSION MEDIUM

Cross-Reference to a Related Application

This application claims priority from provisional application USSN 60/196,687, filed April 12, 2000.

Background of the Invention

Graded index plastic optical fiber (GI-POF) offers promise as a high bandwidth communication medium. The ability to create a desired index of refraction profile in a plastic optical fiber

Methods of manufacture of this material have been proposed in US Patent Nos. 5,593,621, and 5,523,660, EP 130838, EP 2682969, JP1-265208, JP3-65904, JP3-64704, and WO87/01071, and Polymer Journal, Vol. 27, No. 3, pp 310-313 (1995). These manufacturing methods, however, suffer from various drawbacks. For example, some methods require the initial production of a graded index preform and subsequent drawing of fiber from the preform, resulting in a low efficiency of production. Other methods rely on a non-uniform radial distribution of a low molecular weight additive in the fiber and, due to the high concentrations by weight of additives which lower the glass transition temperatures of the fiber, can result in fiber which does not meet the thermal stability requirements for certain applications.

Brief Summary of the Invention

The subject invention pertains to a method and apparatus for manufacturing a plastic optical transmission medium. A specific embodiment of the subject method can allow continuous high-speed production while controlling the refractive index profile of the optical transmission medium, and can produce optical transmission medium with high optical transmission and good thermal stability.

a higher refractive index and not containing and additives in accordance with a specific embodiment of the subject invention

Figure 5b shows GRIN profile modifications due to a fourth layer of melt polymer with a lower refractive index and not containing any additives in accordance with a specific embodiment of the subject invention.

Figure 6a Shows a cross-section of a GRIN-POF having an outer tubing and a jacket in accordance with the subject invention.

Figure 6b Shows a cross-section of a GRIN-POF having a jacket acting as an outer tubing in accordance with the subject invention.

Figure 7a Shows a cross-section of two GRIN POF's with each surrounded by an outer tubing and a jacket surrounding and holding together the fibers in accordance with the subject invention.

Figure 7b Shows a cross-section of two GRIN POF's with a jacket acting as an outer tubing and holding the fibers together in accordance with the subject invention.

Detailed Disclosure of the Invention

The subject invention pertains to a method and apparatus for manufacturing a plastic optical transmission medium. The subject method can allow continuous high-speed production while controlling the refractive index profile of the optical transmission medium, and can produce optical transmission medium with high optical transmission and good thermal stability.

In a specific embodiment of the subject invention, two or more concentric cylinders of transparent polymer melts in which are dissolved one or more transparent low molecular weight diffusible additive(s) can be utilized to produce a plastic optical transmission medium. Cylinders of melt can be extruded into a solidified polymeric tube via, for example, a cross-head type of die. The tube containing the melt materials can be maintained at high temperature for a specific time period, such that the additives diffuse within the polymeric tube and, in particular, from the polymer melt in which they were dissolved into the adjacent melts, to produce a desired index profile. The additives and

Example 1

It is a preferred embodiment of the present invention to manufacture GI-POF which is stable in the temperature range –40° to +85°C, has an optical attenuation ≤ 150dB/km, a parabolic refractive index profile, and a numerical aperture of ~0.15.

The considerations described earlier on the choice of materials are followed in detail. Polymethylmethacrylate is chosen as the polymer with the median refractive index, i.e.,

$(n_{axis} + n_{outer})/2 = 1.492$. The desired numerical aperture of ~0.15 may be written as

$0.15 = \frac{1}{\sqrt{2}}\sqrt{(n_{axis}^2 - n_{outer}^2)}$ which yields $n_{axis} = 1.500$ and $n_{outer} = 1.484$.

The refractive indices of the three polymer matrices are then selected as 1.496, 1.492, and 1.488. These index values are shown in the third column of Table 5 and the choices of monomers to achieve these indices are shown in column 1. The resulting glass transition temperatures of the polymers are given in column 2.

Additives are chosen with indices of 1.63 and 1.305 so as to minimize the amount of additive needed (≤ 3% by weight) to achieve the required refractive indexes of the blends which are shown in the last column. The effect of the additives on the glass transition temperature of the polymer matrices is to depress their Tg's by less than about 10°C as indicated in Figure 1.

Table 5. The Polymeric and Additive Materials are shown for a Three-Component Melt System for Producing a GI-POF With Numerical Aperture Equal to 0.15 and Glass Transition Temperature Greater Than 85°C.

Polymer Matrix			Additive				Material Blend Containing (co)polymer Plus Additive	
Monomer	Polymer Glass Transition Temp.	Refractive		Refractive	Required %w of	Effect on Tg (°C)		Refractive Index

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Material	(°C)	Index	Material	Index	Additive	from Additive	Tg (°C)	Index
95%w MMA +5%w PMA	101.5	1.496	Diphenyl Sulphide	1.63	3.0%	-10.5	91	1.50
MMA	101	1.492					101	1.492
95.5%w MMA +4.5%w 3FMA	100.1	1.488	Methyl perfluoro-octanate	1.305	2.0%	-7.1	93	1.484

The three materials have glass transition temperatures of 91°C, 101°C, and 93°C. The fact that the Tg of all parts of the GI-POF is greater than 90°C is a preferable condition for high thermal stability of the fiber. A second condition for achieving thermal stability of the profile is that the additives be chosen for their chemical affinity for their polymeric matrices. In the case of diphenyl sulphide, the electronic structure of the sulphur atom provides a weak bond to an oxygen atom in the ester unit of the polymers. This bond tends to immobilize the additive at temperatures below the material glass transition temperature. In the case of the methyl perfluorooctanate, there is a direct attraction between the ester units which are present in the additive and the polymer. Once more, this weak bond provides a degree of immobilization of that additive at temperatures below the material glass transition temperature.

The three monomer systems were placed in three tubes with the addition of 0.3% by weight of benzoil peroxide (BPO) acting as initiator, 0.05% by weight of normal butyl mercaptan (nBM) acting as a chain transfer agent. The diphenyl sulphide additive at 3.0%w was dissolved in the high refractive index monomer mix and the additive methyl perfluorooctanate at 2.0%w was added to the low refractive index monomer mix. The solutions were heated to 55°C for 15 hours, 75°C for 5 hours, 100°C for 10 hours, and 150°C for 24 hours. At that time, 99% conversion to polymer was measured. A piston on top of each melt exerted 21 kg/cm^2 pressure to force the melts into the die depicted in

Claim 13 (original):

The method according to claim 12, wherein the two different kinds of polymers have refractive indices n_1 and n_2 such that $n_1 > n_2$, wherein two non-polymerizing additives with refractive indices n_1^1 and n_2^1 such that $n_1^1 > n_1$ and $n_2^1 < n_2$ are added with the two different kinds of polymers, respectively, and wherein the plastic optical transmission medium has a refractive index profile which is substantially parabolic.

Claim 14 (original):

The method according to Claim 12, wherein the two different kinds of polymers have refractive indices n_1 and n_2 such that $n_1 \geq n_2$, wherein a non-polymerizing additive with the refractive index n_2^1 such that $n_2^1 < n_1$ is added with the polymer having refractive index n_2, and wherein the plastic optical transmission medium has a refractive index profile which varies only over a short distance around the interface between the two polymers.

Claim 15 (original):

The method according to Claim 12, wherein the two different kinds of polymers have refractive indices n_1 and n_2 such that $n_1 \geq n_2$, wherein a non-polymerizing additive with the refractive index n_1^1 such that $n_1^1 > n_1$ is added with the first polymer having refractive index n_1, and wherein the plastic optical transmission medium has a refractive index profile which varies only over a short distance around the interface between the polymers.

Claim 16 (original):

The method according to Claim 1, wherein the polymeric tube comprises three concentric cylinders of polymeric material comprising a first, second, and third polymer, respectively, with refractive indices n_1, n_2, and n_3 such that $n_1 > n_2 > n_3$, wherein the first and third polymers have added non-polymerizing additives with refractive indices n_1^1 and n_3^1 such that $n_1^1 > n_1$ and $n_3^1 < n_3$, wherein the plastic optical transmission medium has a refractive index profile which is substantially parabolic.

Claim 17 (original):

The method according to claim 1, wherein the polymeric materials are melt-processable, amorphous materials.

Claim 18 (original):

The method according to claim 1, wherein the polymeric materials comprise a material selected from the group consisting of: polymethylmethacrylate, polyphenylmethacrylate, polytrifluoroethylmethacrylate, polycarbonate, polyfluoroacrylates, amorphous fluorinated polymers; poly 2,2-bis (trifluoromethyl)-4,5 difluoro 1,3-dioxoline-cotetrafluoroethylene, or poly 2,2,4,5-tetrafluoro 1,3-dioxol-4,5-yl tetrafluoroethylene.

Claim 19 (original):

The method according to claim 1, wherein at least one of the diffusible additives increases the refractive index of organic polymers and is selected from the group consisting of: benzophenome, biphenyl, 3-phenyltoluene, diphenyl sulphide and 1,2,4,5-tetrabromobenzene.

Claim 20 (original):

The method according to Claim 1, wherein at least one of the diffusible additives increases the refractive index of perfluorinated polymers and is selected from the group consisting of: N-pentafluorophenyldichlomaleimide, octofluoronapthalene, and pentafluorophenyl sulfide.

Claim 21 (original):

The method according to claim 1, wherein at least one of the diffusible additives decreases the refractive index of organic polymers and is selected from the group consisting of: tributylphosphate, triethylphosphate, glycerol triacetate, methylperfluorooctanate, and perfluoro2,5,8-trimethyl-3,6,9-trioxadodecanoic acid methyl ester.

Claim 29 (previously presented):

The method according to claim 1, further comprising inducing cross-linking in the polymeric material of the polymeric tube.

Claim 30 (original):

The method according to claim 29, wherein said cross-linking is accomplished by exposing the plastic optical transmission medium to ultra-violet radiation.

Claims 31-41 (canceled)

Claim 42 (currently amended):

The method, according to claim ~~39~~1,

wherein continuously admitting said polymeric tube surrounded by the outer tubing into heated enclosed comprises at a speed of at least 5000 meters/hour.

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